

**Q2: What kind of activities are covered by the rule's requirements regarding flammable or explosive gases? What kind of equipment and maintenance is typically needed to meet the requirement for explosive gas monitoring?**

**A2:** The primary activity that would call for explosive gas monitoring would be a consolidation process for flammable gases or liquids. The rule does not require explosive gas monitoring at facilities where consolidation or similar activities do not occur unless there is a risk of explosive gas accumulation. Explosive gas monitoring systems are also called "combustible gas detection" systems because the equipment detects the concentration of combustible gases. When flammable liquids or aerosol cans containing flammable liquids are bulked or consolidated they will generate combustible or potentially explosive vapors. These wastes would include, but are not limited to, substances such as non-chlorinated solvents and thinners, gas propellants, gas and liquid fuels, and oil-based paints and stains.

The potentially explosive vapors will not explode if the concentration is too low, that is, below the lower explosive limit (LEL) for that gas. To warn workers when the concentration of vapors may be increasing to hazardous levels, an explosive (combustible) gas monitoring system must detect concentrations below the lower explosive limit. When the concentration exceeds 10 percent of the lower explosive limit, the workers would be alerted by an alarm and can then take actions to prevent the concentrations from increasing to critical (combustible or explosive) levels. Some systems also allow a second alarm level which is set at a higher percent of lower explosive level, often 25 percent. The actions in response to an alarm might include cessation of bulking, covering of any open containers, allowing the ventilation system to clear the accumulated vapors from the area, and notifying the facility safety manager.

There is a wide range of possible flammable liquids and associated vapors that can be generated. A combustible gas sensor typically can detect many types of vapors generated from flammable liquids. Combustible gas sensors have a range of sensitivity depending on the specific flammable gas that is present in the air. On the scale of sensor responses to a wide variety of flammable gases, concentrations of methane result in an average response by most sensors. Consequently, when a variety of miscellaneous flammable gases may be present, methane is often chosen to be the calibration gas for combustible gas sensors.

Because the generation of the potentially explosive flammable vapors is associated with active waste handling, it is most appropriate to have the explosive gas monitoring system permanently installed in that area. A handheld monitor is difficult to use effectively at the same time the flammable liquids are being processed and could require more staff than many facilities have available. Personal monitors may not be in the location where the higher concentrations of vapors are most likely to accumulate and will be unavailable to monitor vapors generated when the employee leaves the area. Typically, a fixed-location sensor is installed low on a wall near the bulking/consolidation point because most flammable liquid vapors are heavier than air and will tend to sink as well as diffuse into the available area. The sensor alarm can be by sound, light, or both and is often installed high on the same or an adjacent wall to the sensor.

Multiple explosive (combustible) gas sensors can be used to provide coverage at different heights to provide safety redundancy in case a sensor malfunctions. Multiple sensors would also be called for in order to monitor different working locations where explosive vapors may be

expected to be generated. Use of multiple sensors typically increases capital costs only marginally when a multi-channel controller is used.

Some flammable gas sensors require periodic calibration and are usually calibrated to methane to represent an average of the broad spectrum of common flammable vapors and gases. Calibration can usually be done by the facility operator and needs to be done in accordance with the manufacturer's specifications. The sensor may be integrated with the alarm, or it may be located in the working area and the monitor and alarm located away from the area expected to have flammable vapors present. The alarm needs to be installed to alert the workers in the consolidation area. Be sure to work with your local fire and building officials for their approval of exact specifications, installation methods, and locations for this equipment.

A brief web search revealed these manufacturers of fixed-location combustible/flammable gas detection/monitoring and alarm systems:

**RKI Instruments** -- <http://www.rkiinstruments.com/pages/fixed.htm>

**Macurco Gas Detection** -- <http://www.macurco.com/>

**Sierra Monitor Corp.** -- <http://www.sierramonitor.com/>

**Enmet Corp.** -- <http://www.enmet.com/>

**Delphian Corp.** -- <http://www.delphian.com/chc.htm>

**Control Instruments Corp.** -- <http://www.controlinstruments.com/area.html>

**Omni Controls Inc.,** -- <http://www.omnicontrols.com/lists/gassentinel.html>

**Thermo Electron Corp.** --  
[http://www.thermo.com/eThermo/CDA/Products/Product\\_Listing/0,1086,13473-101,00.html](http://www.thermo.com/eThermo/CDA/Products/Product_Listing/0,1086,13473-101,00.html)

**Sentech Industries Inc.** -- <http://www.sentech-ind.com/crowcon/crowcon.htm>

**Note:** This list of companies is for information only and should not be assumed to be comprehensive or complete. The Department of Ecology does not evaluate, endorse, or approve equipment manufacturers or their products.